TECHNICAL NOTE

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The Use of Amalgam Powder and Calcium Hydroxide to Recreate a Radiopaque Image of a Lost Dental Restoration*

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ABSTRACT: Radiographs of dental restorations are highly reliable when used to identify postmortem dental remains. A problem exists if key dental restorations are missing or defective, which results in the loss of a comparative radiographic image. This article describes a simple method allowing the odontologist to quickly recreate a temporary radiopaque restoration. This article presents a method of using amalgam powder (radiopaque material) and calcium hydroxide (radiopaque material and transport medium for the amalgam powder) to recreate a radiopaque image on a tooth that has lost a dental restoration. Amalgam powder and calcium hydroxide is easily obtained (in any dental office), fairly clean, easy to manipulate, inexpensive, inert, stable, and able to be removed without damaging the dental remains. The amalgam powder/calcium hydroxide mixture can easily be re-shaped or modified to reflect the radiopaque image of the original restoration. Radiographic comparison of the "restored" dental remains to the antemortem radiographs is now possible. The use of this technique is presented in a case report.

KEYWORDS: forensic science, odontologist, postmortem dental restoration loss, human identification, X-ray analysis

The dental radiograph is an extremely important comparison tool in the identification process of recovered remains. A radiograph of a single dental filling may show enough characterization in its radiographic silhouette to confer uniqueness. A positive dental identification is established when the concordance between antemortem and postmortem data confers uniqueness and there are no incompatible inconsistencies (1). A problem exists when a restoration from a tooth is displaced (either antemortem or postmortem), resulting in the loss of the radiopaque comparison shape required for identification of the dental remains.

When a dentist prepares a tooth for a restoration, multiple factors will determine the end result of the preparation: size/shape of tooth, size/shape and location of the caries, resistance, and retention form. Since all teeth exhibit a unique silhouette that can be used for radiographic comparison, the floor of a dental restoration preparation will also create a unique feature that could possibly be used as a comparative feature.

The purpose of this article is to present a method that reversibly recreates the basic shape/size of a lost restoration and a general detail of the preparation floor. The radiopaque image that is created by this restoration is now available for comparison with any applicable ante-mortem radiographs.

Materials

The materials used in this technique include amalgam powder, calcium hydroxide pulp capping paste (Fig. 1), mixing pad, ball-point applicator dental instrument, water, a fine-tipped paintbrush, dental explorer, a dental carving instrument (Tanner 5) and a standard dental X-ray machine.

Methods/Technique Description

Extracted teeth with an existing restoration were selected for the illustration of this technique. Infectious control procedures were maintained while handling all freshly extracted teeth. Extracted teeth were disinfected by their placement in 5.25% sodium hypochlorite for 10 min., then rinsed in distilled water. Teeth were then stored in distilled water. All teeth were radiographed and photographed. All radiographs were produced on a digital radiography unit at 10 mA, 70 kVp for 6/60 s and a charged coupled device sensor. Restorations were then removed with a high speed dental hand piece being careful not to disrupt the floor and walls of the preparation.

Amalgam powder is carefully added to the floor of the preparation by using a small amount of water and a fine paintbrush. By completely covering the floor of the preparation, the clinician will help recreate the internal contours of the preparation. Amalgam powder can then be added to a mixture of calcium hydroxide base and powder until a uniform color is observed (Figs. 2 and 3). This combination can then be placed in the cavity preparation. The working time for calcium hydroxide is approximately 2–3 min. If it is determined that an inadequate amount of calcium hydroxide/amalgam powder has been used, an additional increment can be added to the "provisional restoration." Upon the complete set of the amalgam powder/calcium hydroxide restoration, a dental carving instrument is used to recontour the external shape of the restoration.

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FIG. 1—*Calcium hydroxide base and catalyst.*

FIG. 3—*Calcium hydroxide and amalgam powder (mixed to a uniform color).*

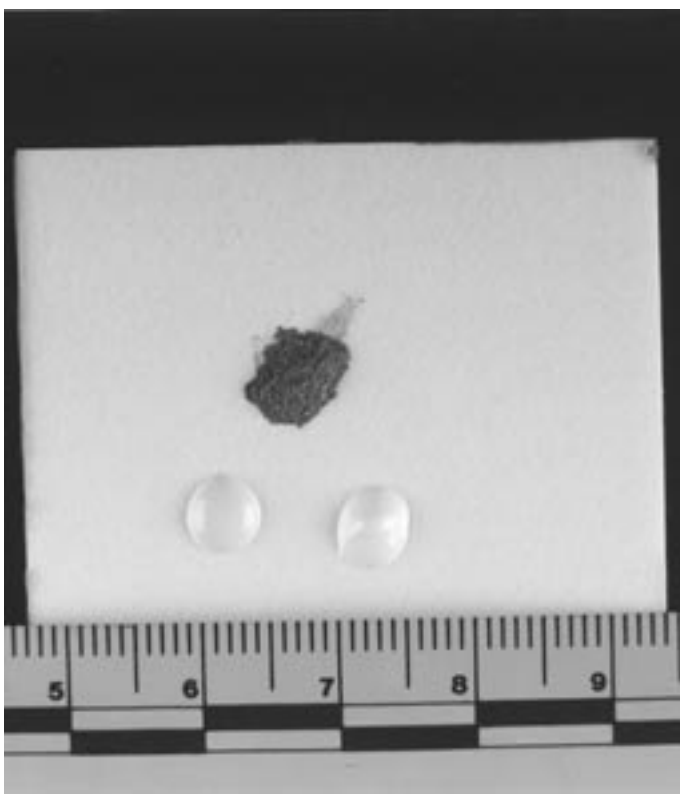

FIG. 2—*Calcium hydroxide and amalgam powder placed on a mixing pad prior to mixing.*

The "provisionally" restored tooth is radiographed and compared to the pre-operative radiographs (Figs. 4–7). External recontouring (addition or removal of the amalgam powder/calcium hydroxide mixture) of the "provisional restoration" can now be determined by the radiographic difference between the post operative and preoperative radiographs.

Upon completion of the clinician's radiographic examination, the "provisional restoration" is easily removed with a dental explorer. The dried amalgam powder can then be removed from the internal surface of the preparation with a damp toothbrush.

Discussion

Radiographs are very important comparative tools for the forensic dentist. Radiographs of restorations are unique to an individual and can be the basis of a positive identification. Since no two dental preparations are exactly alike, the floor and walls of the preparation are unique features that may possibly be used for radiographic comparison.

Robins et al. states that the life expectancy for complex amalgam restorations is 50% at 11.5 years (2). The Smales et al. study showed that complex amalgams had a functional rate of 72% at 15 years (3). In a retrospective study, Stoll et al. found that the ten year survival rate for mesial occlusal gold inlays was 88.3 and 83.4% for distal occlusal gold inlays (4). Because dental restorations do not last forever, it is not inconceivable to think that dental remains could be found with a lost or defective restoration. The recreation of a radiopaque shape that would simulate a lost restoration could assist the forensic dentist in the identification process.

Calcium hydroxide and amalgam are two materials that are found routinely in the majority of dental offices. Fibers in the calcium hydroxide such as calcium tungstate or barium sulfate provide for the material's radiopacity (5). The silver component in the amalgam powder produces the radiopacity in dental amalgam restorations. In this study, the addition of amalgam powder to the calcium hydroxide mixture did not delay its set time.

Reproducing the exact radiographic image can be quite time consuming. Typically, multiple radiographs are taken from various angles, such that the image of the preoperative image can be duplicated. Materials that are not dimensionally stable would result in a distorted radiographic image if the clinician did not complete the procedure in the allotted time period. For the forensic odontologist, calcium hydroxide's minimal dimensional change (shrinkage) with time is a very important selection factor.

FIG. 4—*Amalgam restored Tooth 19.*

FIG. 5—*Tooth 19 restored with radiopaque medium.*

FIG. 6—*Amalgam restored tooth #19.*

FIG. 7—*Tooth #19 restored with radiopaque material.*

It is of utmost importance that the dental remains are not damaged. Materials that may potentially damage the remains or are difficult to remove could present a major problem. The calcium hydroxide/amalgam powder restoration is initially dislodged by carefully inserting a dental explorer and undermining the restoration. The remnants of the temporary restoration can then be removed in a scrapping motion. The internal surface of the tooth can now be brushed with a damp toothbrush and rinsed clean of any dental material residue.

It is important to note that amalgam can be purchased with or without its mercury component. Manufacturers commonly supply capsules containing 400, 600, or 800 mg of alloy and the appropriate amount of mercury (6). By purchasing and utilizing amalgam powder only, the handling, disposal, and potential health hazard problems of mercury is eliminated.

It is not the intent of this technique to recreate an exact copy of the antemortem restoration—a task that would be virtually impossible to complete—but to produce a radiopaque image that will disclose the contour of the preparation floor. The contour of the preparation floor can then be used as an identifying feature due to its exclusive shape.

Case Report

Remains of a U. S. servicemember lost in a plane crash in 1967 included approximately thirty osseous fragments and a coronally fractured Tooth #29: mandibular right second premolar (Fig. 8). Clinical examination of Tooth #29 revealed a shear fracture of the lingual cusp (Fig. 9) and evidence of a dental restoration present (internal walls of the tooth prepared for a restoration and a base filling material) at one time. Radiographs and dental records for the individual who was believed to be lost in this incident were obtained and compared to the dental remains. The dental records indicated that Tooth #29 had a distal-occlusal gold inlay and a mesial pit amalgam restoration. Under microscopic examination, Tooth #29 appeared to have divergent walls (no undercuts) and beveled cavosurface margins (arrow in Fig. 10) consistent with a gold inlay restoration.

Tooth #29 was photographed and radiographed prior to placement of any radiopaque material. The amalgam powder/calcium hydroxide mixture was placed in increments. Radiographs of the "restored" dental remains were taken. Antemortem radiographs were compared to those of the temporarily restored dental remains (Figs. 11 and 12).

A radiograph of the "provisional restoration" reveals a consistent shape when compared to the preparation floor of the antemortem restoration. The uniqueness of the preparation floor is strong evidence relating the dental remains to the previously unidentified service member. The dental evidence was later pre-

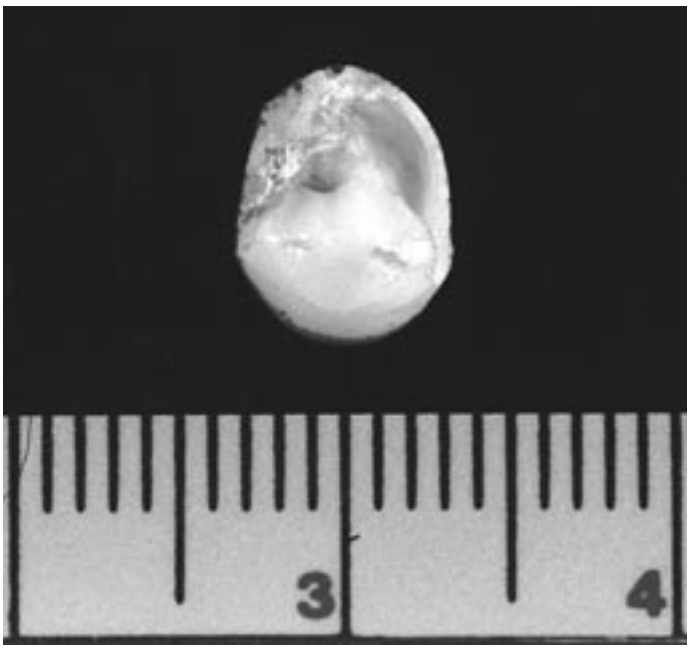

FIG. 9—*Occlusal view of tooth #29 with shear fracture of the lingual cusp.*

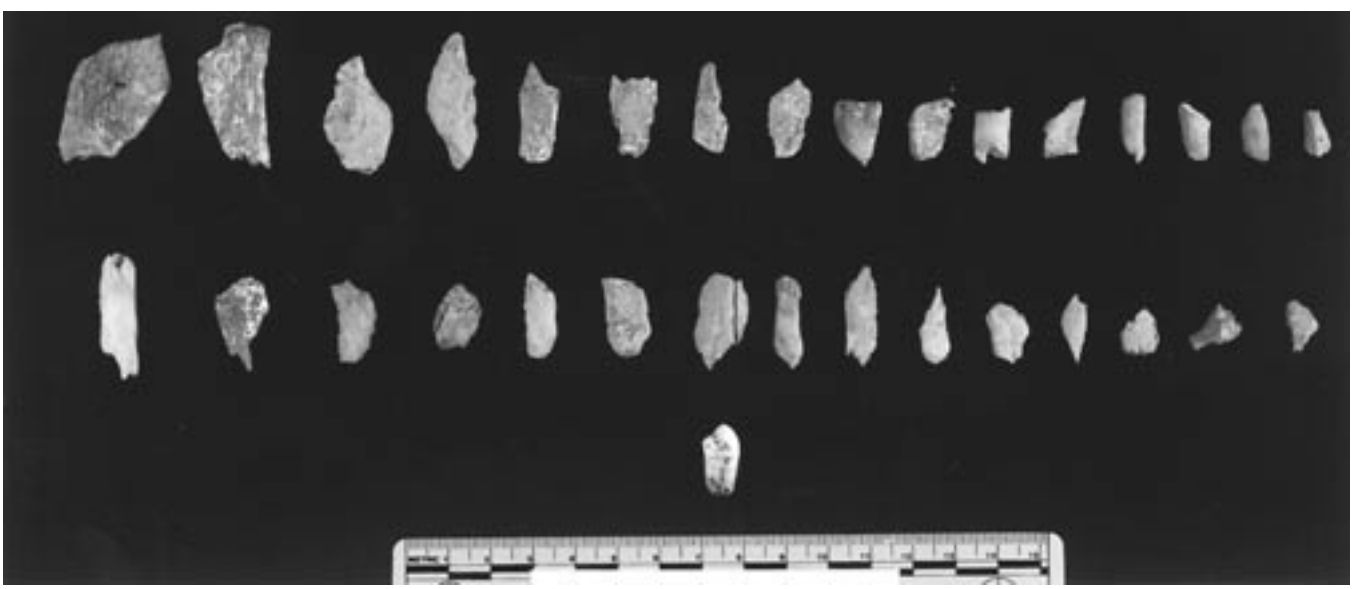

FIG. 8—*Skeletal and dental remains.*

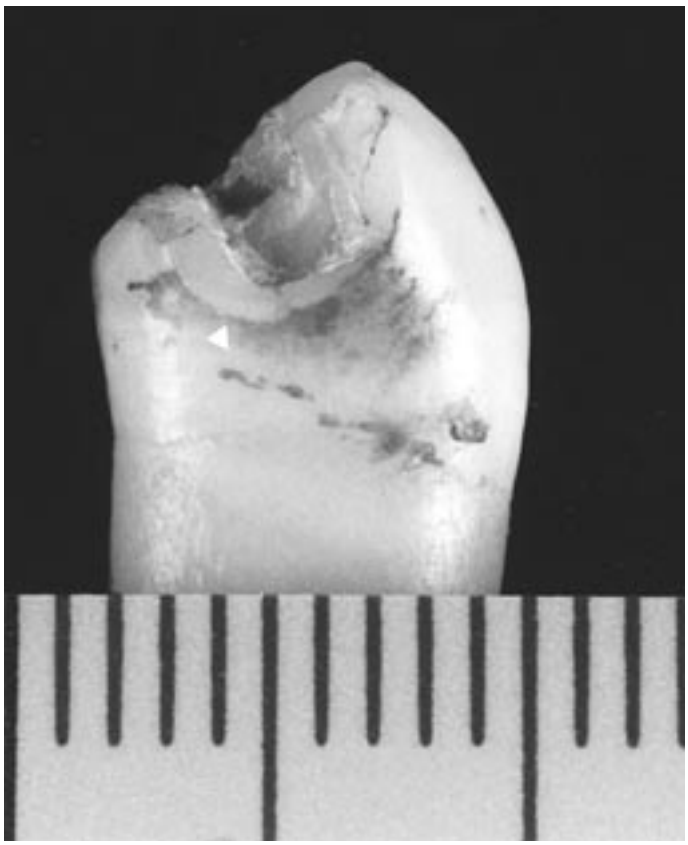

FIG. 10—*Distal view of tooth #29 with a beveled cavosurface margin.*

FIG. 11—*Enlarged digitized segment of antemortem bitewing radiograph.*

FIG. 12—*Radiograph of tooth #29 restored with "provisional restoration."*

sented and approved by a forensic review board and representatives of the identified service member.

Conclusion

The technique described in this article is quick and simple. The materials are inexpensive, easily accessible, and easily removed from the tooth. The recreated radiopaque restoration can now be used for radiographic comparison and postmortem identification. This technique can be performed by anyone with minimal training in the dental materials used and access to an X-ray unit.

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